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21. A PROFILE OF THE FOOD AND FEEDING OF HILLSTREAM TELEOSTS OF GARHWAL HIMALAYAS

Hillstreams of the Garhwal Himalayas are either glacier- and snow-fed (mostly larger and perennial streams such as Yamuna, Tons, Bhagirathi, Alaknanda, Mandakini, Pindar), nonglacier- and/or spring-rain-fed. Almost all the hillstreams of the Garhwal Hills (especially in their meta- and hyporhithron zones) harbour abundant and diverse ichthyofauna, reflecting a diversity of habitat, food and location of migratory routes.

Occupied Habitats

The category of hillstream fishes, based on feeding habits, are:

1. Surface feeders, e.g. *Barilius bendelisis*, *B. vagra*, *B. barila*, *B. barna*, *Xenentodon cancila* and *Esomus dauricus*.

2. Column feeders, e.g. *Schizothoraichthys progastus*, *Puntius chola*, *P. sophore* and *P. sarana*, and

3. Bottom feeders, e.g. *Schizothorax plagiostomus*, *S. richardsonii*, *Garra* spp., *Crossocheilus latius latius*, *Glyptothorax* spp. and *Pseudecheneis sulcatus*.

There is no convincing method of differentiating the feeding sites from non-feeding sites. It may be indirectly inferred from observations on gut contents and seasonal variations of feeding.

Das and Moitral (1963, 1965) classified the feeding habits of fishes from the Central Himalayan streams (including Garhwal Himalaya) as: i. Herbivorous (75% of food is plant material), ii. Omnivorous (plant and animal material approximately 50% each), and iii. Carnivorous (animal material constitutes over

75%). Later, two categories were added, Herbi-omnivorous (greater amount of plant material) and Carni-omnivorous (a greater amount of animal material). Twenty-seven teleost species from Garhwal Himalaya have been classified according to their feeding habits (1993) (Table 1).

According to Nikolsky's (1963) scheme, based on variation in the type of food consumed, most fishes from Garhwal rivers (especially the 27 reviewed in Table 1) are either euryphagic (take a wide variety of food items) or stenophagic (feed on few types of food) except a few, viz. *Pseudecheneis sulcatus*, *Glyptothorax pectinopterus*, *G. conirostris*, *G. telchitta* which feed only on a single category of food, e.g. larvae and nymphs of aquatic insects.

Peculiar features and adaptations for food selection

The basic morphology of the feeding apparatus, common to all teleosts, differs in form according to the species, and is adapted to a particular mode of feeding (Larkin 1979). The primary feeding adaptations of herbivore fish are structural in nature. Food capture by carnivores generally requires more elaborate techniques, as potential prey has its own behavioural and structural arrangements for avoiding capture.

Hillstream fishes of Garhwal region live under ecological conditions that may be stressful and less favourable for optimal feeding. These fishes have evolved numerous adaptations to this environment, some of which affect their food gathering and feeding:

MISCELLANEOUS NOTES

TABLE I
FEEDING HABITS AND BASIC FOODS OF SOME HILLSTREAM TELEOSTS

Feeding habits	Fish species	Basic foods	Special remarks
Herbivorous	<i>Schizothorax richardsonii</i>	algae, diatoms and surface scraps of the bottom	bottom feeder benthophagous and detritophagous
	<i>S. plagiostomus</i>	"	"
	<i>S. sinuatus</i>	"	"
	<i>Crossocheilus latius latius</i>	"	"
	<i>Garra gotyla gotyla</i>	"	"
	<i>G. lamta</i>	"	"
	<i>Labeo dyocheilus</i>	diatoms and algae	bottom feeder
Herbi-omnivorous	<i>L. dero</i>	"	"
	<i>Puntius chilinoides</i>	diatoms, algae, aquatic weeds and their larvae	"
Omnivorous	<i>Tor</i> spp.	"	"
	<i>Puntius ticto</i>	-	-
	<i>P. chola</i>	-	-
	<i>Chagunius chagunio</i>	-	-
	<i>Barililus bendelisis</i>	-	-
	<i>B. barila</i> <i>B. barna</i>	-	-
Carni-omnivorous	<i>Schizothoraichthys progastus</i>	insect larvae, crustaceans pre-dominant but aquatic weeds and algae also present	-
	<i>B. vagra</i>	"	-
	<i>Noemecheilus multifasciatus</i>	"	-
	<i>N. rupicola</i>	"	-
	<i>N. montanus</i>	"	-
Carnivorous	<i>Pseudecheneis sulcatus</i>	aquatic insects, their larvae and nymphs	bottom feeder and monophagic
	<i>Glyptothorax telchitta</i>	"	"
	<i>G. pectinopterus</i>	"	"
	<i>G. conirostrus</i>	"	"
	<i>B. bola</i>	-	-
	<i>Mastacembelus armatus</i>	insects, larvae and nymphs; small sized fishes also present	predator

a) The mouth opening in the bottom feeders, bottom scrapers, burrowers and mud suckers (*Garra gotyla gotyla*, *G. lamta*, *Schizothorax plagiostomus*, *S. richardsonii*, *Crossocheilus latius latius*, *Pseudecheneis sulcatus*, *Glyptothorax* spp.) is wide and situated ventrally and subventrally instead of being terminal as in other teleosts. A hard scraping plate in the lower jaw, posterior to the mouth opening, helps in scraping the detritus. In *Tor tor* and *Schizothoraichthys progastus*, the mouth is suctorial and funnel-shaped, formed by the eversion and modification of lips. *Mastacembelus armatus* has an upperjaw and lip longer than the lower one, a well developed dental

battery in both jaws, suitable for predation.

b) Location of food depends on the sensory capabilities, of the fish. Vision is important in species with large prominent eyes, while the non-visual senses are important in fishes with reduced visual capability (Aleev 1969). This is common among fishes living at the bottom or in conditions of reduced light. Accordingly, the fish species are described as sight feeder (using visual stimuli while gathering food) and nose feeders (using olfactory cues for feeding). The strictly surface and column feeder carnivores (predators, piscivore and larvivore), and herbivorous fishes are sight feeders, whereas, bottom feeders

(detritophagous and mud suckers) are nose feeders (Table 1.)

Based on the observation of the major gut contents and food preference under normal and, abnormal situations, the various food items may be described as:

1. Basic food - major part of gut contents throughout the year.
2. Secondary food - frequent in gut contents, but lesser than basic foods.
3. Obligatory food - forced to take under stress and food scarcity.
4. Incidental food - of rare occurrence.

Reduction in availability of 'preferred' prey resources

Degradation of favourable feeding sites leads to adverse qualitative and quantitative impacts on the growth of planktonic and benthic communities. This causes in turn serious disruption of the food chain and the energy cycle in the early phases of the life cycle of omnivorous, herbi-omnivorous, carni-omnivorous and carnivorous fish species. Food availability, the nature of feeding grounds and stimuli-feeding responses are less compatible with the adaptations/specialisations for torrential rapids in the hillstreams, particularly in case of bottom dwellers and feeders; the water current

has played a significant role in their evolution.

Alterations in water quality are also brought about by the addition of silt, explosives, large rocks (a result of dam/barrage construction) as well as irrational fishing methods.

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N. SINGH

Zoology Department,
HNB Garhwal University,
Srinagar, Garhwal 246 174.

R. SUBBARAJ

Department of Animal Behaviour,
School for biological Sciences,
Madurai Kamaraj University,
Madurai 625 021, Tamil Nadu, India.

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22. A SUPPLEMENTARY LIST OF THE HOST-PLANTS OF INDIAN LEPIDOPTERA

Indian Lepidoptera are comparatively well known. The early stages and biology of all species of economic importance are known, but little emphasis has been placed on the remaining

species. These constitute the vast majority and are of significance in bio-diversity studies.

The opportunistic rearing of eggs from gravid females and larvae discovered in the field